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Theoretical Study of a Plasma Accelerator

The two-dimensional unsteady flow established in a traveling wave plasma accelerator was subjected to a purely theoretical analysis in order to help explain, and possibly predict, phenomena appearing during experiments on the problems of acceleration of an ionized fluid plasma. This study is of particular importance because plasma acceleration has a diversity of applications, such as plasma injectors used in controlled thermonuclear fusion and electric propulsion systems used in space.

Plasma accelerators come in a variety of designs: pulsed or continuous; dc or ac; with or without electrodes. The specific accelerator studied was an electrodeless traveling wave device in which the ionized fluid remained nearly neutral during operation. In this system, an unsteady traveling magnetic field is created, and currents are induced in the plasma. Interaction of the currents with the magnetic field creates the acceleration of the ionized fluid.

The small-perturbation theory, under conditions of small magnetic Reynolds number and weak electromagnetic interaction, was used for the study. The partial differential equation for pressure was solved using a Laplace transform, and the remaining quantities desired

were derived from the pressure through the integration of simple equations. Finally, the analytical results were computed numerically to clarify the effects of the various parameters.

Note:

The following documentation may be obtained from:

National Technical Information Service
Springfield, Virginia 22151
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Reference:

(N67-16558). Two-Dimensional Unsteady Flow in a Traveling Wave Plasma Accelerator

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No patent action is contemplated by NASA.

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Category 03